Designation: E677 – 94 (Reapproved 2016)

Standard Specification for Interchangeable Spherical Ground Joints[1]

This standard is issued under the fixed designation E677; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers standard dimensional requirements for obtaining, within practical limits, interchangeability in spherical ground joints for ordinary laboratory and industrial applications. It covers dimensional interchangeability of the ground surfaces only and does not involve design characteristics of the item except where specified, nor does it involve physical or chemical characteristics of the material used.

NOTE 1—The dimensions pertaining to spherical ground joints were taken from the Commercial Standard CS 21–58 of the U.S. Department of Commerce.

NOTE 2—Although glass is the most commonly used material for ground joints, other materials may be used as specified. Spherical joints constructed from glass shall conform to Specifications E438 and E671.

1.2 The following precautionary caveat pertains only to the Test Method portion, Section 4, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E438 Specification for Glasses in Laboratory Apparatus

E671 Specification for Maximum Permissible Thermal Residual Stress in Annealed Glass Laboratory Apparatus

E920 Specification for Commercially Packaged Laboratory Apparatus

E921 Specification for Export Packaged Laboratory Apparatus

E1133 Practice for Performance Testing of Packaged Laboratory Apparatus for United States Government Procurements

E1157 Specification for Sampling and Testing of Reusable Laboratory Glassware

2.2 *U.S. Department of Commerce Standard:*

CS 21 Interchangeable Taper-Ground Joints, Stopcocks, Stoppers, and Spherical-Ground Joints[3]

3. Requirements

3.1 *Socket Member*—The design of the socket member is shown in Fig. 1. The contour of the ground area shall be spherical, with a radius of curvature equal to one half of the gaging ball diameter specified in Table 1 as a minimum. The contour of the shoulder shall be essentially spherical and concentric with the ground area. When tested in accordance with 4.2, socket members shall show a continuous circumferential line of contact with the gaging ball.

3.2 *Ball Member*—The design of the ball member is shown in Fig. 1. The contour of the ground area shall be spherical, with a radius of curvature equal to one half of the gaging ball diameter as specified in Table 1 as a maximum. The contour of the shoulder shall be essentially spherical, approximately concentric with the ground area and with a slightly smaller radius to provide a short offset at or slightly beyond the line of the gaging diameter. Ball members shall meet the reduced pressure test (4.3) when assembled with a socket member complying with 3.1.

3.3 *Size Designation*—The size designation of joints shall be the accepted nominal gaging diameter, plus the inside diameter of the joint within the ball member, both expressed in millimetres and separated by a line. Therefore, the designation 18/7 means that the nominal gaging diameter of the joint is 18 mm and the inside diameter of the joint is 7 mm.

3.4 *Dimensions*—The size designations and essential dimensions of joints are shown in Table 1. Only the sizes listed shall be considered standard.

3.5 *Interchangeability*—When assembled ball-and-socket members are paired at random and tested under reduced pressure, the leak rates shall not exceed those specified in 4.3.

4. Test Methods

4.1 *Gaging the Ball*—Gaging balls shall have dimensions and tolerances shown in Table 1.

[1] This specification is under the jurisdiction of ASTM Committee E41 on Laboratory Apparatus and is the direct responsibility of Subcommittee E41.01 on Laboratory Ware and Supplies.

Current edition approved Sept. 1, 2016. Published September 2016. Originally approved in 1980. Last previous edition approved in 2004 as E677 – 94 (2010). DOI: 10.1520/E0677-94R16.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] *Discontinued 1979*—U.S. Department of Commerce, Washington, DC 20234.

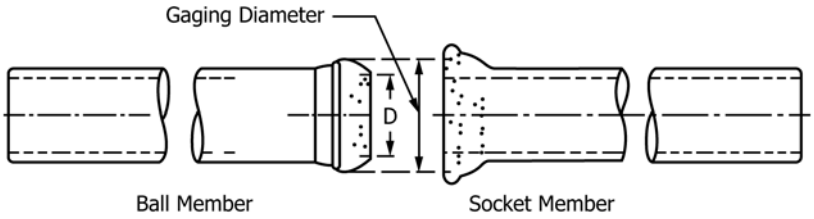


FIG. 1 Diagram of Ball-and-Socket Members

TABLE 1 Spherical Ground Joints

Joint Size Designation	Nominal Gaging Diameter, mm	Dimension *D* (approximate), mm	Gaging Ball Diameter, mm
7/1	7	1.0	7.144 ± 0.001
12/1	12	1.0	12.700 ± 0.003
12/1.5	12	1.5	12.700 ± 0.003
12/2	12	2.0	12.700 ± 0.003
12/3	12	3.0	12.700 ± 0.003
12/5	12	5.0	12.700 ± 0.003
18/7	18	7.0	19.050 ± 0.003
18/9	18	9.0	19.050 ± 0.003
28/12	28	12.0	28.575 ± 0.004
28/15	28	15.0	28.575 ± 0.004
35/20	35	20.0	34.925 ± 0.004
35/25	35	25.0	34.925 ± 0.004
40/25	40	25.0	41.275 ± 0.004
50/30	50	30.0	50.800 ± 0.004
65/40	65	40.0	63.500 ± 0.005
75/50	75	50.0	76.200 ± 0.006
102/75	102	75.0	101.600 ± 0.008

4.2 *Gaging the Socket*—Sockets shall be tested against a gaging ball. The ball shall enter the socket and the line of contact shall be continuous circumferentially. This line may be obtained with the use of a film of Prussian blue or stopcock grease applied to the gaging ball.

4.3 *Leakage*—Use the leak test apparatus illustrated in Fig. 2, or one functionally similar to it, with the average differential pressure during the test kept above 600 mm Hg. Conduct the test as follows:

4.3.1 Clean both joints to be tested with distilled water, and then dry them with a clean paper towel. Next, wipe the ground zones with a clean chamois to remove any remaining particles.

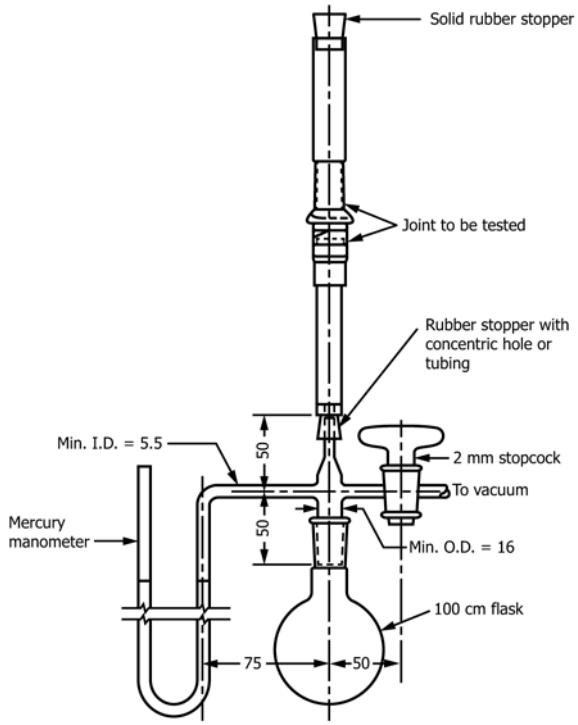
4.3.2 Tightly close the unground end of the joint to be connected to the manometer system, using a rubber stopper containing a concentric hole (or rubber tubing, depending upon the joint size under test) sized to fit snugly on the manometer connection, and mount the joint on the connection in an upright position.

4.3.3 Firmly plug the unground end of the other type of joint with a solid rubber stopper.

4.3.4 Carefully mate the ground surfaces of the joints without exerting any pressure on them.

4.3.5 Gently apply a 225-g weight on the upper joint for seating pressure; then rotate the upper joint 90° and remove the weight.

4.3.6 After ensuring that the stopcock to the vacuum pump is in the closed position, turn on the pump, and adjust the stopcock to the pump so that the mercury in the manometer



NOTE 1—Evacuated volume of manometer tubing, connections, and flask shall be 100 to 150 cm^3. Joint volume shall be added for leak rate calculation.

NOTE 2—Leak rate of apparatus shall not exceed 5 % of that of joint being tested. Spherical joints constructed from glass shall conform to Specifications E438 and E671.

NOTE 3—Dimensions are in millimetres and are approximate, except for minimum diameters.

FIG. 2 Schematic Representation of Leak Test Apparatus

rises to a level such that the average differential pressure will remain above 600 mm Hg at the conclusion of the test.

4.3.7 Allow air leakage to occur through the mated joints for a timed interval, and note the change in differential pressure.

4.3.8 Repeat 4.3.4 – 4.3.7 once, ensuring in 4.3.5 that the upper joint is rotated 90° from its position in the first test.

4.3.9 *Calculation*—Compute the leak rate in torr·L/s or Pa·L/s as follows:

$$\text{Leak rate} = (\Delta P)(V)/T \quad (1)$$

where:

ΔP = maximum change in differential pressure noted in test, mm Hg or Pa,

V = total evacuated volume, including manometer tubing, connections, flask, and joints, L, and

T = time of test, s.

The leak rate shall not exceed the following values:

Joint Size	Leak Rate	
	torr·L/s	Pa·L/s
7/1 to 12/5	0.15	20.0
18/7 to 28/15	0.30	39.9
35/20 to 75/50	0.45	59.8
102/75	0.60	79.8

5. Marking

5.1 Interchangeable spherical ground joints conforming to this specification shall be marked on both members with the symbol SJ indicating spherical joint, the size designation, and the trademark of manufacturer or distributor. This symbol is the manufacturer's assurance to purchasers that the item identified by the symbol is a standard interchangeable size and type described and is manufactured within the tolerances permitted by this specification. It shall not be used on joints nor in advertising description of joints of any size or type other than those described in this standard.

6. Sampling and Testing

6.1 For sampling and testing refer to Specification E1157.

7. Packaging

7.1 For packaging, select from Specifications E920 or E921 or Practice E1133.

8. Keywords

8.1 ground; joints; spherical